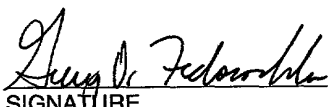| FORM PTO-1390U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV 10-2000) TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	ATTORNEY'S DOCKET NO. 006020.00017
	U.S. APPLICATION NO (If known, See 37 CFR 1 5) TB 10/018781

INTERNATIONAL APPLICATION NO PCT/AU00/00700	INTERNATIONAL FILING DATE 22 June 2000	PRIORITY DATE CLAIMED 25 June 1999

TITLE OF INVENTION
IMAGE CONVERSION AND ENCODING TECHNIQUES

APPLICANT(S) FOR DO/EO/US
Philip Victor HARMAN et al.

Applicant herewith submits to the United State Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.

2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.

3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).

4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).

5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))

    a. ☐ is attached hereto (required only if not communicated by the International Bureau).

    b. ☒ has been communicated by the International Bureau.

    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2).

7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))

    a. ☐ are attached hereto (required only if not communicated by the International Bureau).

    b. ☐ have been communicated by the International Bureau.

    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.

    d. ☒ have not been made and will not be made.

8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11-16 below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.

12. ☐ An Assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.

13. ☒ A FIRST preliminary amendment.

    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☒ Other items or information:

International Search Report (ISA/AU)

U.S. APPLICATION NO. (If known, See 37 CFR 1.5) TBA 10/018781	INTERNATIONAL APPLICATION NO. PCT/AU00/00700	ATTORNEY'S DOCKET NO 006020.00017	
17. ☒ The following fees are submitted: **Basic National Fee (37 CFR 1.492(a)(1)-(5):**		CALCULATIONS	PTO USE ONLY

		CALCULATIONS	PTO USE ONLY
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1,040.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$890.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.455(a)(2)) paid to USPTO	$740.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$710.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$1040.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e).		$0.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	26	-20 =	6	X $18.00	$108.00	
Independent Claims	2	- 3 =	0	X $ 84.00	$0.00	
Multiple dependent claims (if applicable)				X $280.00	$0.00	

	CALCULATIONS	
TOTAL OF ABOVE CALCULATIONS =	$1148.00	
☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated below above are reduced by 1/2.	$574.00	
SUBTOTAL =	$574.00	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f).	$0.00	
TOTAL NATIONAL FEE =	$574.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property.	$0.00	
TOTAL FEES ENCLOSED =	$574.00	

+	Amount to be: refunded	$
	charged	$

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 19-0733 in the amount of <u>$574.00</u> to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0733. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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1001 G Street, N.W.
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Telephone: (202) 508-9100

SIGNATURE

Gary D. Fedorochko
Registration No. 35,509

Date: December 21, 2001

<u>IN THE UNITED STATES PATENT AND TRADEMARK OFFICE</u>

In re the Application of:	Atty. Dkt. No.: 006020.00017
Philip Victor HARMAN et al.	
Serial No.: TBA	U.S. National Stage of
Filed: Herewith (December 21, 2001)	International Application No.:
For: IMAGE CONVERSION AND ENCODING TECHNIQUES	PCT/AU00/00700

<u>PRELIMINARY AMENDMENT</u>

BOX PCT
Commissioner for Patents
Washington, D. C.   20231

Sir:

Prior to examination and calculation of any claim fees, please amend the instant application as follows:

<u>IN THE ABSTRACT</u>:

Following the Claims section, insert the attached Abstract of the Disclosure.

<u>IN THE SPECIFICATION</u>:

Page 1, after the title of the invention, insert the following section:

CROSS REFERENCE TO RELATED APPLICATIONS:

This is a U.S. National Phase Application under 35 U.S.C. § 371 of International Application No. PCT/AU00/00700 filed June 22, 2000, which was published Under PCT Article 21(2) in English, which claims priority to Australian Application No. PQ1197, filed June 25, 1999, the entire contents of which are incorporated herein by reference.

IN THE CLAIMS:

Please replace claims 1-23, with the following new claims 24-49.

24.   (New) A method of encoding a depth map including:

identifying and outlining an object within an image;

allocating an object identification symbol to said object;

using the allocated object symbol to represent the shape of said object; and

allocating said object with a depth.

25.   (New) A method as claimed in claim 24 wherein said object identification symbol is an alphanumeric character.

26.   (New) A method as claimed in claim 24 wherein said object identification symbol is a symbol.

27.   (New) A method as claimed in claim 24 wherein said object is filled with said object identification symbol.

28.   (New) A method as claimed in claim 24 further including the step of:

compressing the information representing said object and its depth.

29.   (New) A method as claimed in claim 28 further including the steps of:

transmitting and/or storing said compressed information; and

decompressing said compressed information.

30.   (New) A method as claimed in claim 29 wherein said decompressing of the information is in real time.

31.   (New) A method as claimed in claim 28 wherein said step of compressing the information uses run length encode for each line of said image.

32.   (New) A method as used in claim 28 wherein each line of said image is compressed by representing the information in the following format:

A(X) . . .

wherein A represents the object identification symbol, and X represents the number of consecutive pixels that A covers.

33.   (New) A method as claimed claim 28 wherein said compressed information is further compressed.

34.   (New) A method as claimed in claim 33 wherein said further compression uses Lenple Ziv, Huffman or Shannon-Fano techniques.

35.   (New) A method as claimed in claim 24 further including the step of:

assigning each said object a depth identifier.

36.   (New) A method as claimed in claim 35 wherein said depth identifier is of the

form:

<object number> <depth flag> <depth operator>

wherein object number is the number allocated to the object, depth flag indicates

the type of depth information, and depth operator are parameters associated with said

depth information.

37.   (New) A method of encoding a depth map including the steps of:

identifying and outlining an object within an image;

allocating an object identification symbol to said object;

defining said object by drawing a plurality of lines across said image, and

determining the start and finish positions of each said line, wherein a new line is

commenced each time an object boundary is reached; and

allocating said object with a depth;

38.   (New) A method as claimed in claim 37, wherein said lines extend horizontally

across said screen.

39.   (New) A method as claimed in claim 37, wherein said lines extend vertically

down said screen.

40.   (New) A method as claimed in claim 37 wherein each said line is defined in the following format:

A,B(x)

wherein A is the depth at the start of the line, B is the depth at the end of the line, and x is the length of the line.

41.   (New) A method as claimed claim 37 wherein each said line is defined in the following format:

A,B(x,C(y,z),r)

wherein A is the depth at the start of the line, B is the depth at the end of the line, x is the length of the line, C(y,z) is the center point of a radial ramp, and r is the radius of said radial ramp.

42.   (New) A method as claimed in claim 24 wherein said objects are painted a color by an operator to assign a depth to said object, said color being predefined for a certain depth.

43.   (New) A method as claimed in claim 42 wherein the color assigned by said operator is a shade of gray ranging from white to black.

44.   (New) A method as claimed in claim 24 wherein said objects are painted a color by an operator, and then said color is assigned a depth value.

45. (New) A method as claimed in claim 24 wherein said depth map is attached to or embedded in said image.

46. (New) A method as claimed in claim 37 wherein said objects are painted a color by an operator to assign a depth to said object, said color being predefined for a certain depth.

47. (New) A method as claimed in claim 46 wherein the color assigned by said operator is a shade of gray ranging from white to black.

48. (New) A method as claimed in claim 37 wherein said objects are painted a color by an operator, and then said color is assigned a depth value.

49. (New) A method as claimed in claim 37 wherein said depth map is attached to or embedded in said image.

REMARKS
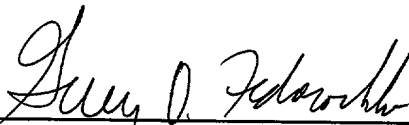
By this amendment, the specification has been amended to include a Cross-Reference to Related Applications section, claims 1-23 have been canceled and new claims 24-49 inserted therefor, and an Abstract is provided on a separate sheet as required. Examination on the merits of the instant application is respectfully requested.

Respectfully submitted,

BANNER & WITCOFF, LTD.

Dated: December 21, 2001   By: _____

Gary D. Fedorochko
Registration No. 35,509

1001 G Street, N.W.
Washington, D.C. 20001-4597
(202) 508-9100

GDF:lab

Attachment:
     Abstract of the Disclosure

ABSTRACT OF THE DISCLOSURE

A method of encoding a depth map including the steps of identifying and outlining an object within an image, allocating an object identification symbol to the object, using the allocated object symbol to represent the shape of the object, and allocating the object with a depth.

IMAGE CONVERSION AND ENCODING TECHNIQUES

FIELD OF INVENTION

The present invention is generally directed towards stereoscopic image synthesis and more particularly toward an improved method of converting two

5 dimensional (2D) images for further encoding, transmission and decoding for the purpose of stereoscopic display.

BACKGROUND

The applicants have previously described in PCT/AU96/00820, a method of producing left and right eye images for a stereoscopic display from an original 2D

10 image including the steps of:

a.)   identifying at least one object within the original image;

b.)   outlining each object;

c.)   defining a depth characteristic for each object; and

d.)   respectively displacing selected areas of each object by a determined

15 amount in a lateral direction as a function of the depth characteristic of each object, to form two stretched images for viewing by the left and right eyes of the viewer.

These steps can be individually and collectively referred to as Dynamic Depth Cuing or DDC.

Additionally, the Applicants have previously described in PCT/AU98/0155, in

20 one aspect a method of encoding a depth map including the steps of:

a.)   allocating an object number to an object;

b.)   allocating the object with a depth; and

c.)   defining the object outline

25   The object or object outline can be defined by a series of co-ordinates, and/or curves, and in particular bezier curves where found to produce desirable results. This system could also be assisted through the use of generic libraries, both in the identification of objects within an image and also the allocation of depth of each object.

30   Further, the Applicants disclosed a method of transmission of the depth map information whereby the information was included in the vertical Blanking Interval or MPEG data stream.

The Applicants' prior developments enabled an operator to simply outline an object and assign a depth to that object. This information was then processed to determine the amount of stretching required in order to place the object at the assigned depth. From an end user point of view this system is intuitive and allows

5 the user to interactively alter the depth of an object to obtain an artistically pleasing result. From a processing point of view, the use of Bezier curves proves a highly efficient means of compressing the necessary data. However, whilst the use of Bezier curves is an efficient compressing technique, it is a relatively complex system to implement. Accordingly, a simplified technique of generating and

10 processing depth maps is desired.

OBJECTIVE OF INVENTION

It is an objective of the present invention to provide a relatively simple technique of generating and processing depth maps, and further improve the operations of the Applicants earlier image conversion and encoding techniques.

15 SUMMARY OF INVENTION

With the above objectives in mind, the present invention provides in one aspect a method of encoding a depth map including:

identifying and outlining an object within an image;

allocating an object identification symbol to the object;

20 using the allocated object symbol to represent the shape of the object; and allocating the object with a depth.

Advantageously, the present invention will include the further steps of:

compressing the information representing the object and its depth;

transmitting and/or storing the compressed information; and

25 decompressing the information.

In another aspect the present invention provides a method of encoding a depth map including:

identifying and outlining an object within an image;

allocating an object identification symbol to the object;

30 defining the object by drawing a plurality of lines across the image, and determining the start and finish positions of each said line, wherein a new line is commenced each time an object boundary is reached;

allocating the object with a depth;

Preferably, the said lines will extend horizontally across the screen. However, it will be appreciated that the lines could equally extend vertically across (or up and down) the screen.

5 BRIEF DESCRIPTION OF THE DRAWINGS

To provide a better understanding of the present invention, reference is made to the accompanying drawings which illustrate a preferred embodiment of the present invention.

IN THE DRAWINGS:

10 Figure 1 shows a group of objects that have been identified, as previously disclosed and allocated a number.

Figure 2 shows how the shape of each identified object may be defined using the object number defined in Figure 1.

Figure 3 shows how the information representing this group of objects can 15 be compressed.

Figure 4 shows an alternative method for representing each object and its depth.

DETAILED DESCRIPTION OF INVENTION

In the preferred embodiment, the image conversion technique includes the 20 following steps:

OBJECT IDENTIFICATION

Objects in the 2D image to be converted may be identified using any of the methods previously disclosed in application PCT/AU98/01005, the contents of which are hereby included herein by reference. For illustrative purposes only, 25 assume that the image to be converted is as per Figure 1. This image consists of four objects, namely a disk which has been allocated object number 1, a triangle that has been allocated object number 2, a square that has been allocated object number 3 and the background that has been allocated object number 4. It will be understood that the objects need not be allocated numerals, and that alphanumeric 30 characters or any other symbol could also be used.

OBJECT REPRESENTATION

As shown in Figure 2 the shape of each of these objects within the image may be defined by using each object identification symbol, in this case a number, to "paint" the shape of the object. Alternatively, it can be considered that the object

5   is "filled" with the object identification symbol. In either event the shape of the object may still be determined such that a user or viewer may still be able to identify the painted object.

As can be seen from Figure 2, object 1 has been reproduced using the symbol 1, object 2 the symbol 2, object 3 the symbol 3 and object 4 the symbol 4.

10   OBJECT COMPRESSION

In order to efficiently store or transmit the information representing the objects shown in Figure 1 it is necessary to compress the information. The compression and decompression process should be able to be undertaken both in software and/or hardware and operate in a fast and efficient manner.

15   In the case of the 2D to 3D conversion of video, where the object information is included in the Vertical Blanking Interval or MPEG stream, it is desirable that the decompression should operate sufficiently rapidly to enable real time 2D to 3D conversion of the associated 2D image.

A simple compression technique is to run length encode for each line of

20   Figure 2. This is shown in Figure 3. The first line of Figure 2 consists of the symbol 4 repeated 50 times. Using run length encoding this would compress to

4(50)

which indicates that the symbol 4 is to be repeated 50 times along that line.

In a similar manner, each line of Figure 2 is processed to produce Figure 3.

25   To decompress Figure 3 the reverse process is applied.

This compression technique can effectively reduce the data required to represent Figure 1 to 20% of its uncompressed value. If desired, additional compression may be applied.

It will be appreciated by those skilled in the art that many other data

30   compression techniques are suitable for this application. This would include, although not limited to, Lenple Ziv, Huffman and Shannon-Fano.

Once an object has been defined using the above process a differential encoding technique can be used to eliminate the need to transfer or store data that is consistent in consecutive images. The differentially encoded data can then be compressed as previously described.

5   DEPTH MAPS

As previously disclosed, in order to use this representation of an object to form a depth map each object needs to be allocated a depth. The manner of defining the depth of an object is as previously disclosed in PCT/AU98/01005. Therefore, each object identified in Figure 1 will have associated with it a depth

10   identifier in the form:

<object number> <depth flag> <depth operator>

Where <depth flag> indicates the type of depth information that follows and <depth operator> are any parameters associated with the specific type of depth flag.

15   This object depth information may be added to the object data stream either before or after compression.

In an alternative embodiment, the image conversion technique includes the following steps:

OBJECT IDENTIFICATION

20   Objects in the 2D image to be converted to 3D are identified as previously described. For purposes of explanation we will use the objects identified in Figure 1.

OBJECT REPRESENTATION

The shape of each object can be represented by drawing a series of

25   horizontal lines across the image such that a new line is started each time an object boundary is crossed. This is illustrated in Figure 4.

The x, y co-ordinates of the starting point of the first line, marked Z1 in Figure 4 will be known and for illustrative purposes will be assigned 0,0. Likewise the end point of the line, marked Z2 in Figure 4, will be known and for illustrative

30   purposes will be assigned 0,255.

Lines (Z1,Z2) (Z3,Z4) Z5,Z6) represent the first few lines of object 4. The values of Zn indicate the depth at which the object is to appear in the final

stereoscopic image. For illustrative purposes we will assume that there are 255 possible depth values, such that depth 0 is closest to the viewer and depth 255 farthest from the viewer.

If, for example, object 4 is to appear at a constant depth 100 from the viewer 5 then the values of Z1 and Z2 would be 100.

If, however, it was desired that object 4 should appear to ramp away from the viewer then Z1 could be set to 50 and Z2 to 100. The 2D to 3D conversion process previously disclosed in PCT/AU98/01005 would then interpolate the depth data and produce the appropriate 3D images.

10 Conversely, should it be desired that object 4 should appear to both ramp away from the viewer and tilt away then Zn-1 could be set to 75 and Zn set to 100.

Referring to Figure 4, the line identified as starting at Z7 would therefore consist of 3 segments as follows:

Z7 to Z8 - which defines the segment of object 4;

15 Z9 to Z10 - which defines the segment of object 3;

Z11 to Z12 - which defines the segment of object 4

Whilst the x, y location of points Z1 to Z7 and Z12 will be known, since they border the image, the location of points Z8 to Z11 are determined by the size of the objects being described, and can be determined from the outline of the object(s).

20 The allocation of depths Za and Zb will allow a linear depth ramp to be applied to an object. However, since it is desirable to add other than linear ramps to an object, for example radial ramps, the centre of the radial ramp (x, y) and its radius (z) will also need to be known.

Thus the general format for a line describing both an objects length and 25 assigned depth is

start_depth, end_depth (length, centre (x, y), radius)

Where start_depth is relative to either the left hand edge of the image or the previous object identification and length, centre and radius may be required depending upon the length of the line (i.e. if the length is not equal to the image 30 width) and assigned depth characteristics.

For example, using start_depths relative to the previous object, and assuming a 0 to 255 by 1 to 255 image with object 4 at a constant depth 50 and

object 3 at a constant depth 20, and assuming that object 3 runs from co-ordinate (76,4) to (200,4), the data for the first 4 lines of Figure 4 will be:

Line 1   50

Line 2   50

5   Line 3   50

Line 4   50, 50, 75 20, 20 125 50, 50, 55

This data can be compressed as previously described or using other compression techniques familiar to those skilled in the art. Similarly, the allocation of a depth for each object is as previously disclosed.

10 ALTERNATIVE PROCESS FOR DEPTH ASSIGNMENT

An alternative method of assigning the depth of an object is to "paint" the object using a graphics paint brush or air brush, such as used in the Adobe Photoshop graphics software, with a colour equal to the depth that is to be assigned to the object.

15 For illustrative purposes assume that there are 256 different depth levels available with 0 representing an object closest to the observer and 255 furthest away from the observer. Assume that depth 0 is assigned to white and 255 to black then intermediate depths will be assigned a shade of grey.

Considering Figure 1, assume that object 1 is to be set to depth 10. The 20 operator selects depth 10 from a pallet which determines a corresponding shade of grey to assign to the graphics paint brush or air brush.

The operator then paints the area of object 1 with the brush, thus allocating depth 10 to the object. Since the operator can see the results of his actions on the computer screen it is possible to accurately select objects.

25 Different size brushes, or air brush patterns, may be selected to allow fine detail or rapid fill of large areas. Errors can be corrected using a graphical eraser such as found, for example, in Adobe Photoshop.

Once the shape of an object has been painted using the brush the depth of the object can be altered if necessary by altering the shade of grey. Standard 30 techniques such as found in graphics drawing packages can be used to change the shade of grey.

Using a mouse, or other locating device, it is possible to add variations in object depth within an object. The variations in depth are applied by selectively changing the shade of grey within the object. Examples of the depth variations include, but are not limited to, linear ramps, non-linear ramps and radial ramps.

5   Painting the object with a shade of grey has been chosen for illustrative purposes only. In practice any colour, shape or symbol may be used to enable the operator to paint the selected object.

A preferred embodiment includes separating the steps of painting the object and selecting the depth of the object. An effective process is to cause the object 10 being painted to take on transparent or glass like texture. This enables the operator to see areas of the object that have already been painted rather than obscuring them with a solid colour. Once the object has been painted in this manner a solid depth colour can be applied.

ALTERNATIVE PROCESS FOR CREATING BEZIER CURVES

15   Since the peripheral edges of the object are known it is possible to locate the boundary of the object and automatically construct Bezier curves that trace the peripheral of the object. The Bezier curves may be adjusted as necessary to cause exact alignment of the object and also adjusted to allow for movement of the object as it moves in successive frames.

20 ALTERNATIVE PROCESS FOR TRANSPORT OF DDC DATA

In previous applications, it has been assumed that the Dynamic Depth Cueing (DDC) data has been imbedded in the original 2D image in either the Vertical Blanking Interval or MPEG stream.

In practice this is a convenient way to transport and store the DDC encoded 25 2D images. However, it will be understood by to those skilled in the art that the DDC data and original 2D images can be stored and transported separately if desired.

For example, if the original 2D image where a video sequence that was held on a data server accessible via the Internet then the DDC data could be accessed 30 from the same server or an entirely different server in a geographically different location. The user could then download the video sequence and DDC data relating

to the video sequence independently and combine them either at the time of viewing or prior to viewing.

The application of the DDC data to the original video sequence to create 3D can be undertaken in real time, as the viewer looks at the images, or off-line prior to

5 viewing. The creation of 3D from the DDC data and the original 2D image can be undertaken in either software or hardware as previously disclosed.

In relation to software conversion from 2D to 3D, a convenient way to achieve this on a Personal Computer (PC) is to provide a software plug-in for an existing 2D viewer. For example, a plug in for the Apple QuickTime movie viewer

10 would be suitable for general PC viewing as would plug-ins for Internet Web browser such as Internet Explorer and Netscape Communicator. These plug-ins could be most conveniently provided to the viewer by downloading over the Internet.

Alternatively a custom software application could be developed and

15 conveniently provided to the user via a download from the Internet or other efficient method.

USE OF DDC FOR THE 2D TO 3D CONVERSION OF STILL IMAGES

A subset of the use of DDC data for the conversion of 2D moving images into 3D is the conversion of still images. The original image may be in any digital

20 format and may have originated from either a film camera, with the resulting image being scanned to produce a digital file, or directly from a digital still or moving camera.

For transfer between Personal Computers and in particular transfer over the Internet, it is desirable that the DDC data is imbedded in a standard image format.

25 Such formats are know to those skilled in the art and include, but are not limited to, JPEG, BMP, GIFF and TIFF.

JPEG and GIFF are compressed formats that also enable the insertion of private data within the image files. In a preferred embodiment the DDC data is included in the private data area of these compressed image formats.

30   This process therefore enables an image containing DDC data to be viewed in either 2D, if the user does not have either a suitable viewer or plug-in, or 3D if a viewer or plug-in is available.

As previously disclosed, DDC data may be used to create both a stereo pair of images and also a number of stereo pairs suitable for use with autostereoscopic displays using lenticular lenses. An example of such a display is that manufactured by Philips which requires 7 or 9 pairs of stereo images.

5   For use with a still image, the DDC data can be used to produce multiple monoscopic or stereoscopic views from an original 2D image. In a preferred embodiment such images could be viewed on a Personal Computer using a Windows interface with the viewpoint selected by moving a horizontal slider bar.

Whilst the method and system of the present invention has been 10 summarised and explained by illustrative examples, it will be appreciated by those skilled in the art that many widely varying embodiments and applications are within the teaching and scope of the present invention, and that the examples presented herein are by way of illustration only and should not be construed as limiting the scope of this invention.

15

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1.   A method of encoding a depth map including:

identifying and outlining an object within an image;

allocating an object identification symbol to said object;

using the allocated object symbol to represent the shape of said object;   and

allocating said object with a depth.

2.   A method as claimed in claim 1 wherein said object identification symbol is an alphanumeric character.

3.   A method as claimed in claim 1 wherein said object identification symbol is a symbol.

4.   A method as claimed in any one of the preceding claims wherein said object is filled with said object identification symbol.

5.   A method as claimed in any preceding claim further including the step of:

compressing the information representing said object and its depth.

6.   A method as claimed in claim 5 further including the steps of:

transmitting and/or storing said compressed information; and

decompressing said compressed information.

7.   A method as claimed in claim 5 or 6 wherein said decompressing of the information is in real time.

8.   A method as claimed in any one of claims 5 to 7 wherein said step of compressing the information uses run length encode for each line of said image.

9.   A method as used in any one of claims 5 to 7 wherein each line of said image is compressed by representing the information in the following format:

A(X)...

wherein A represents the object identification symbol, and X represents the number of consecutive pixels that A covers.

10.   A method as claimed in any one of claims 5 to 9 wherein said compressed information is further compressed.

11.   A method as claimed in claim 10 wherein said further compression uses Lenple Ziv, Huffman or Shannon-Fano techniques.

12.   A method as claimed in any preceding claim further including the step of:
       assigning each said object a depth identifier.

13.   A method as claimed in claim 12 wherein said depth identifier is of the form:
       <object number> <depth flag> <depth operator>
       wherein object number is the number allocated to the object, depth flag indicates the type of depth information, and depth operator are parameters associated with said depth information.

14.   A method of encoding a depth map including the steps of:
       identifying and outlining an object within an image;
       allocating an object identification symbol to said object;
       defining said object by drawing a plurality of lines across said image, and determining the start and finish positions of each said line, wherein a new line is commenced each time an object boundary is reached; and
       allocating said object with a depth;

15.   A method as claimed in claim 14, wherein said lines extend horizontally across said screen.

16.   A method as claimed in claim 14, wherein said lines extend vertically down said screen.

17.   A method as claimed in any one of claims 14 to 16 wherein each said line is defined in the following format:

A,B(x)

wherein A is the depth at the start of the line, B is the depth at the end of the line, and x is the length of the line.

18.   A method as claimed in any one of claims 14 to 16 wherein each said line is defined in the following format:

A,B(x,C(y,z),r)

wherein A is the depth at the start of the line, B is the depth at the end of the line, x is the length of the line, C(y,z) is the centre point of a radial ramp, and r is the radius of said radial ramp.

19.   A method as claimed in any preceding claim wherein said objects are painted a colour by an operator to assign a depth to said object, said colour being predefined for a certain depth.

20.   A method as claimed in claim 19 wherein the colour assigned by said operator is a shade of grey ranging from white to black.

21.   A method as claimed in any one of claims 1 to 18 wherein said objects are painted a colour by an operator, and then said colour is assigned a depth value.

22.   A method as claimed in any preceding claim wherein said depth map is attached to or embedded in said image.

23.   A method or system substantially as hereinbefore described with reference to the accompanying drawings.

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Published:
— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMAGE CONVERSION AND ENCODING TECHNIQUES
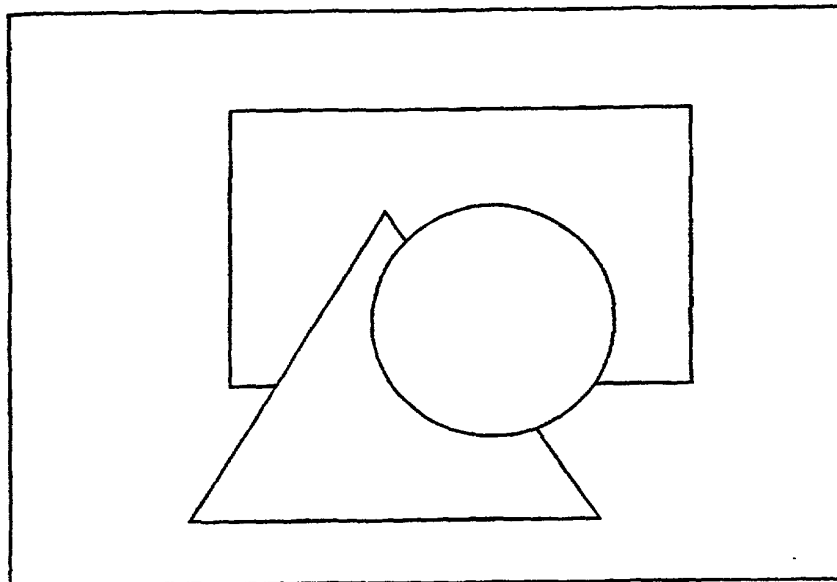
(57) Abstract: A method of encoding a depth map including the steps of identifying and outlining an object within an image, allocating an object identification symbol to the object, using the allocated object symbol to represent the shape of the object, and allocating the object with a depth.
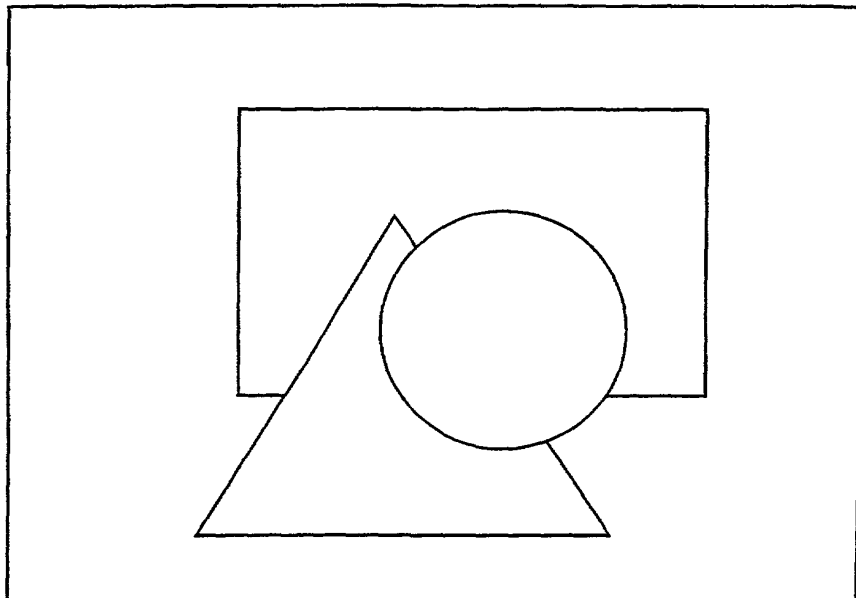
Fig 1.

Fig 2.

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44444444444444333333  221 1 1 1 1 1 1 1 1 1 1 1 33333344444444444
444444444444443333  2221 1 1 1 1 1 1 1 1 1 1 1 .333334444444444
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444444444444444 2222222222222222.44444444444444444444
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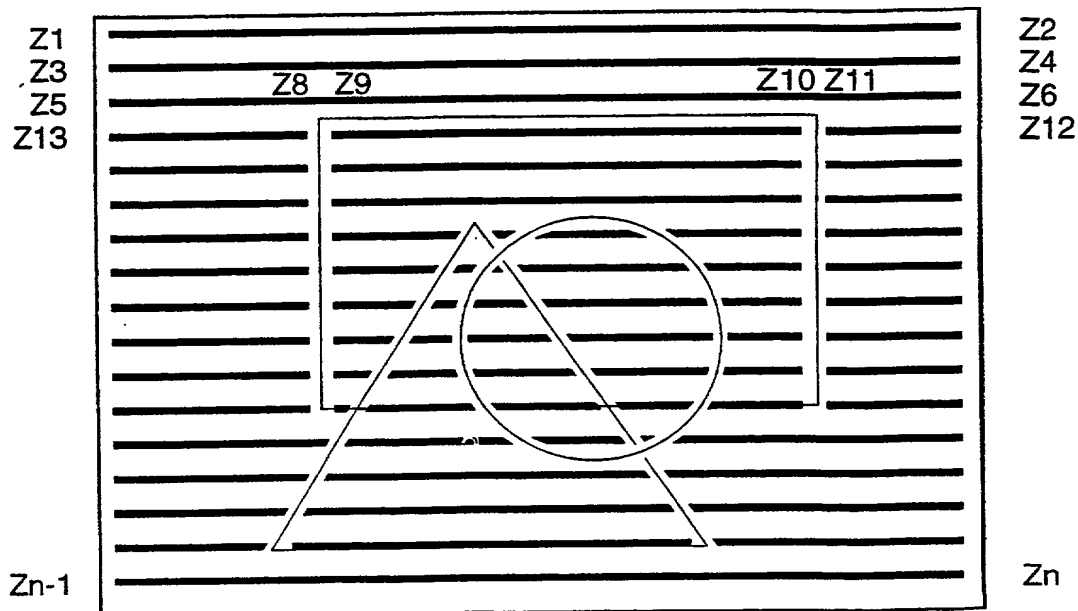## Fig 3

2(50)					
2(50)					
2(50)					
2(50)					
2(50)					
2(10)	3(28)	4(12)			
2(10)	3(28)	4(12)			
2(10)	3(10)	2(1)	1(7)	3(5)	4(12)
2(10)	3(9)	2(2)	1(11)	3(3)	4(12)
2(10)	3(7)	2(3)	1(14)	3(3)	4(12)
2(10)	3(6)	2(4)	1(16)	3(1)	4(12)
2(10)	3(5)	2(6)	1(14)	3(2)	4(12)
2(10)	3(3)	2(8)	1(11)	3(3)	4(12)
2(10)	3(2)	2(11)	1(7)	3(3)	4(12)
2(11)	2(20)	4(19)			
2(10)	2(22)	4(18)			
2(9)	2(24)	4(17)			
2(50)					
2(50)					

Fig 4.

JOINT DECLARATION FOR PATENT APPLICATION

As the below named inventors, we hereby declare that:

Our residence, post office address and citizenship are as stated below next to our names;

We believe we are the original, first and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled <u>Image Conversion and Encoding Techniques</u>, the specification of which

☐   is attached hereto.

☒   was filed on <u>December 21, 2001</u> as Application Serial Number <u>10/018,781</u> and was amended on <u>December 21, 2001</u> (if applicable).

☒   was filed under the Patent Cooperation Treaty (PCT) and accorded International Application No. <u>PCT/AU00/00700</u>, filed <u>June 22, 2000</u>, and amended on _____ (if any).

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We hereby acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Prior Foreign Application(s)

We hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Country	Application No.	Date of Filing (day month year)	Date of Issue (day month year)	Priority Claimed Under 35 U.S.C. §119
Australia	PQ1197	25 June 1999		yes

Prior United States Provisional Application(s)

We hereby claim priority benefits under Title 35, United States Code, §119(e)(1) of any U.S. provisional application listed below:

U.S. Provisional Application No.	Date of Filing (day month year)	Priority Claimed Under 35 U.S.C. §119(e)(1)

Prior United States Application(s)

We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Date of Filing (Day, Month, Year)	Status — Patented, Pending, Abandoned

Power of Attorney

And we hereby appoint, both jointly and severally, as our attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith the practitioners at:

Customer Number: 22907   (WDC)

Please address all correspondence and telephone communications to the address and telephone number for this Customer Number.

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature _____   Date __22-4-02__

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